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# Bescheinigung

# Certificate

# Attestation

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The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

**Patentanmeldung Nr.** **Patent application No.** **Demande de brevet n°**

00204790.0

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

I.L.C. HATTEN-HECKMAN

DEN HAAG, DEN
THE HAGUE, 28/08/01
LA HAYE, LE

# Blatt 2 der Bescheinigung
# Sheet 2 of the certificate
# Page 2 de l'attestation

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Demande n°:

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Anmelder:
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Demandeur(s):
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Display device and cathode ray tube

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Display device and cathode ray tube

The invention relates to a display device as defined in the precharacterizing part of claim 1.

The invention also relates to a cathode ray tube which is suitable for use in a display device.

Such a display device is used in, *inter alia*, television displays and computer monitors.

A display device of the kind as mentioned in the opening paragraph is known from EP-A 509590 described which is provided with deflection unit and a cathode ray tube having an in-line electron gun. The electron gun comprises a main lens portion having means for generating a main lens and a first quadruple field. During operation, the intensity of said fields is dynamically varied. This enables astigmatism and focussing of the electron beams as a function of deflection to be controlled so that astigmatism caused by the deflection is at least partly compensated and that the electron beams are substantially in focus every where on the display screen. The electron gun comprises a pre-focussing lens portion having means for generating a prefocussing lens field and a further quadrupole field. In the known device, during operation the intensity of said fields is controlled so that a dynamically lens is formed in the prefocussing lens portion for reducing the beam angle in the vertical direction. In the known display device the intensity of the dynamic voltage is applied to the means for generating dynamically the quadrupole field.

In display devices according to the state of the art having, on the outer side of display screen, a real flat surface, disturbing pictures may occur in particular at the edges of the display screen. For example, characters may become less distinct as they are closer reproduced at the corners of the display screen.

It is an object of the invention to provide a display device having an improved picture quality. This object is achieved by the display device according to the invention as

specified in claim 1. The invention is, inter alia, based on the insight that by providing an auxiliary field which intensity is adapted such that the trajectories of the electrons of the beam leave the main lens substantially parallel and the diameter of the electron beam in the direction perpendicular with the in-plane direction is much smaller compared to the diameter of the electron beam in the direction parallel to the in-line plane, the trajectories of the electron beam in the direction perpendicular with the in-plane direction substantially coincides with the main axis of main lens. Therefore, the effect of the lens is virtually zero and the spot is in focus everywhere on the screen during deflection of the electron beam. Furthermore, the spot size in the direction perpendicular with the in-plane direction on the display screen is substantially uniform in the center as well as in the corners of the display screen. As a result the picture quality is improved. In the known display device the trajectories of electrons at the outside of the beam passes the main lens with a relatively large diameter in the direction perpendicular with the in-plane direction and the spherical aberration of the electron beam due to the main lens is large and the electron beam becomes out of focus at the corners of the display screen.

In a known display device in a direction perpendicular with the in-plane direction an increasing positive effect of the prefocussing lens and a converging effect of the second dynamically quadrupole reduces the beam angle of the electron beam entering the main lens and an increasing negative effect of the first quadrupole and a decreasing positive effect of the main lens maintains focus of the electron beam in the corners as well as in the center of the display screen.

A further advantage is that because the application of a static auxiliary field a dynamic voltage for generating dynamic auxiliary fields is not required anymore.

In this patent application horizontal is to be understood in a direction parallel to the in-line plane and vertical is to be understood in a direction transversely the in-line plane. Furthermore, a quadrupole field modulates the shape of an electron beam. It reduces the size of the electron beam in one direction and it increases the size of an electron beam in a direction perpendicularly to said direction.

An astigmatic field modulates the shape of an electron beam in such a way that the size of an electron beam is reduced in an horizontal direction as well as in the vertical direction, but the reduction in the vertical direction is larger than the reduction in the horizontal direction.

A prefocusing field influences, that is increases or reduces, the size of an electron beam in all directions to an approximately equal degree.

A particular embodiment of the display device according to the invention is specified in dependent claim 2. One possibility to obtain the auxiliary electric field is to apply a first quadrupole field in the main lens section and a second quadrupole field in the prefocus. lens section. In this design the quadrupole fields can established by fixed potentials on the different grids. An advantage of this design is that it enables much degrees of freedom for optimizing the electron gun.

A different embodiment of the display device according to the invention is specified in dependent claim 5. Another possibility to obtain the auxiliary lens field is to apply an astigmatic lens field in the prefocus lens section. This design of the display device requires a relatively simple electron gun with only a few grids.

Further advantageous embodiments of the display device according to the invention are claimed in the dependent claims.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

In the drawing:

Fig. 1 shows a sectional view of a display device,

Fig. 2 shows a sectional view of a first example of an electron gun which can suitable be used in a cathode ray tube for a display device,

Figs 3. shows a sectional view of a second example of an electron gun which can be suitable used in a cathode ray tube for a display device and

Fig. 4 shows a simulation of a beam section of a display device in the vertical direction and the horizontal direction of the display device.

The display device comprises a cathode ray tube, in this example a color display tube 1, having an evacuated envelope 2 which consists of a display window 3, a cone portion 4 and a neck 5. In the neck 5 there is provided an electron gun 6 for generating three electron beams 7, 8 and 9 which extend in one plane, the in-line plane which in this case is the plane of the drawing. A display screen 10 is provided on the inside of the display window. Said display screen 10 comprises a large number of phosphor elements luminescing in red, green and blue. On their way to the display screen 10, the electron beams 7, 8 and 9 are deflected across the display screen 10 by means of deflection unit 11 and pass through a

color selection electrode 12 which is arranged in front of the display window 3 and which comprises a thin plate with apertures 13. The color selection electrode is suspended in the display window by means of suspension means 14. The three electron beams 7, 8 and 9 pass through the apertures 13 of the color selection electrode at a small angle with each other. Consequently, each electron beam impinges on phosphor elements of only one color. The display device further comprises means 15 for generating voltages which, in operation, are applied to components of the electron gun.

Fig. 2 is a sectional view of a first example of an electron gun which is suitable for use in a cathode ray tube in a display device according to the invention. The electron gun 6 comprises three cathodes 21, 22 and 23. It further comprises a first common electrode 24 ($G_1$), a second common electrode 25 ($G_2$), a third common electrode 26 ($G_3$), a fourth common electrode 27 ($G_{41}$), a fifth common electrode 28 ($G_{42}$), a sixth common electrode 29 ($G_{43}$), a seventh common electrode 30 ($G_{44}$) and an eight common electrode 31 ($G_5$) .Electrodes 31 ($G_5$) and 30 ($G_{44}$) form an electron-optical element in the main lens portion of the electron gun for generating a main lens field which is formed, in operation, between said electrodes 30 and 31 in space 32. Alternatively, the main lens portion can be formed by a distributed composed main lens field. (DCFL).

Furthermore, in this example, the apertures 251, 252 and 253 in electrode 25 ($G_2$) are round, as are the apertures 264, 265 and 266 in electrode 26 ($G_3$). In operation, a rotationally symmetrical prefocusing lens is formed between the electrodes 25 and 26.

The electrodes have connections for applying electric voltages. The display device comprises leads, not shown, for applying electric voltages which are generated in the means 15. The cathodes and the electrodes 24 and 25 form the so-called triode portion of the electron gun. Electrodes 25 ($G_2$) and 26 ($G_3$) form an electron-optical element in the prefocusing portion of the electron gun for generating a first prefocusing field approximately in space 36.

Particularly in the case of color display tubes having a substantial (for example 110° or more) angle of deflection and a real flat display screen, disturbing effects may occur because the spot is not uniform over the display screen.

In order to improve the spot uniformity during deflection of the electron beam over the screen, electrodes 30 ($G_{44}$) and 29 ($G_{43}$) form an electron-optical element in the main lens portion of the electron gun for generating an auxiliary electric field, in this example a first quadrupole field which, in operation, is generated between the electrodes 30 and 29 in space 33.

Furthermore, electrodes 27 ($G_{41}$), 28 ($G_{42}$) and 29($G_{43}$) form an electron optical element in the prefocussing portion of the electron gun for generating a first further auxiliary electric field, in this example a second quadrupole field in space 34 between electrode 28(G42) and 29(G43). Electrodes 27 ($G_{32}$) and 26 ($G_{31}$) form an electron-optical element in the prefocusing portion of the electron gun for generating a second further auxiliary electric field, in this example, a third quadrupole field in space 35 between the electrodes 26 and 27. All electrodes have apertures for transmitting the electron beams. In this example, apertures 281, 282 and 283 are rectangular as are apertures 284,285 and 286. This is diagrammatically shown by means of rectangles beside the apertures. Apertures 271,272 and 273, apertures 274, 275 and 276, and apertures 277, 278 and 279 are also rectangularly shaped as is diagrammatically shown beside said apertures. Apertures 264,265 and 266 are also rectangularly shaped as is diagrammatically shown by means of a rectangle besides the apertures.

In operation, a potential Vfoc is applied to electrode 30 ($G_{44}$), 28 ($G_{42}$) and 26($G_3$). Said potential Vfoc is for example 6900 V. Furthermore, a potential $V_{G5}$ of approximately 25 kV to 30 kV is applied to electrode 31 ($G_5$), also termed anode. The electron beams are deflected across the display screen 10 by deflection unit 11. The electromagnetic deflection field also has a focusing effect and causes astigmatism. Said effects are governed by the deflection angle of the electrons. The apertures are selected so that the effect of the potential applied to electrode 30 ($G_{44}$) on the beam size in the horizontal direction and brought about in the main lens is of opposite sign, as the effect on the beam size in the horizontal direction brought about in the first quadrupole field causing a net positive lens action in the horizontal direction. Furthermore, in the vertical direction the lens actions of the main lens field and the first quadrupole field intensify each other and together with lens actions of the second and third quadrupole fields causing the electron beam to leave the main lens substantially parallel to the in-line plane whereby the diameter of the electron beam at an aperture of electrode 31 ($G_5$) of the main lens is smaller than or equal to the diameter of the aperture 251,252,253 of the second electrode 45 ($G_2$) throughout the deflecting of the electron beam across the display screen 10. It has to be noted that the diameter of the electron beam 7,8,9 varies with the anode current. So for small currents in the order of 1 mA the diameter of the electron beam 7,8,9 in the vertical direction at an aperture of the electrode 31($G_5$) of the electron gun 6 will be less than the aperture of the second electrode G2. However, for high currents, i.e. more than 3 mA, the diameter in the vertical direction at a gap of the main lens at the anode side of the electron gun will be larger than the aperture of

the second electrode G2. In practice, for nominal beam currents of approximately 2 mA the diameter in the vertical direction at a gap of the main lens at the anode side of the electron gun will be equal to the aperture of the second electrode G2.

Table 1 and Table 2 show half the beam angle in the x-direction (x) and in the y-direction (y) of the electron beams on the display screen, as a function of the potential $V_{foc2}$ applied to electrode 26 ($G_{31}$) and 28($G_{42}$) at a beam current of 0.5 mA and 2.0 mA respectively. In this example, it holds that:

diameter of apertures in electrode 25 ($G_{2a}$): 0.580 mm
diameter of apertures in electrode 25 ($G_{2b}$): 0.490 (x) x 0.520 (y) mm
diameter of apertures in electrode 26 ($G_{3a}$): 0.390 (x) x 0.430 (y) mm
diameter of apertures in electrode 26 ($G_{3b}$): 2.000 (x) x 4.000 (y) mm
apertures 264, 265 and 266: 4 (x) x 0.9 (y) mm
apertures 271, 272 and 273: 4.5 (x) x 1.8(y)mm
apertures 274, 275 and 276: 1.8 (x) x 4.5(y)mm
apertures 277, 278 and 279: 4.5 (x) x 1.8(y)mm
apertures 281, 282 and 283: 2.95 (x) x 7.0(y)mm
apertures 284, 285 and 286: 4.8 (x) x 2.95(y)mm

where the potential $V_{G2}$ applied to electrode 25 ($G_2$) is approximately 700 Volts and the potential Vfoc applied to electrodes 27($G_{41}$) and 29 ($G_{43}$) is approximately 5400 Volts.

Table 1, half the beam angle in the x- and y-directions as a function of the dynamic potential $V_{foc2}$ at a beam current of 0.5 mA.

| $V_{foc2}$ (Volt) | Half the beam angle (mrad) at 0.5 mA | |
|---|---|---|
| | X | Y |
| 5400 (0 V) | 13 | 22 |
| 5900 (500 V) | 26 | 6 |
| 6400 (1000 V) | 41 | 1 |
| 6900 (1500 V) | 56 | 0 |

Table 2, half the beam angle in the x- and y-directions as a function of the dynamic potential $V_{foc2}$ at a beam current of 2.0 mA.

| $V_{foc2}$ (Volt) | Half the beam angle (mrad) at 2.0 mA | |
|---|---|---|
| | X | Y |
| 5400 (0 V) | 22 | 58 |
| 5900 (500 V) | 42 | 27 |
| 6400 (1000 V) | 65 | 9 |
| 6900 (1500 V) | 89 | 0.5 |

The beam section in a direction (in this example the x or y-direction) on the display screen is governed by the beam angle in said direction, in the following manner: the beam angle is the angle (α) at which the electron beam enters the main lens. For a main lens it holds that the Helmholtz-Lagrange product (HL) is constant in a first-order approximation, which product complies with the equation

$$HL = \frac{\alpha}{2} * B * \sqrt{V}$$

wherein B represents the beam section in the direction in question and V represents the voltage applied to the anode. The beam section increases as the beam angle decreases.

The beam angle and, hence, the beam section in the vertical (y)-direction as well as the beam angle and, hence the beam section in the horizontal (x)- direction can be varied substantially, as shown in Table 1 and Table 2, by varying the potential $V_{foc2}$ applied to electrode 26 ($G_3$), 28($G_{42}$) and 30($G_{44}$). In order to obtain a electron beam with a diameter equal to the diameter of the aperture of electrode 45 ($G_2$) the potential $V_{foc2}$ is set at 6900 V.

In the example, the quadrupole fields are generated between two electrodes having quadrangular apertures. The apertures may alternatively be oval, elongated or polygonal;

A quadrupole field may be generated in a different manner, for example, by raised, oppositely located edges at apertures for transmitting electron beams;

In operation, the first quadrupole field may be located, viewed in the direction of travel of the electron beams, in front of or behind the main lens field or be integrated therein.

It is advantageous when the means for generating the prefocusing field and the quadrupole field are constructed so that it can be excited with only one voltage, as is the case in the example stated above. In this example the voltage is applied to the common electrode $G_{31}$.

In order to improve the second quadrupole field and the third quadrupole field it is also possible to exchange the plate electrode 26 ($G_3$) with a bus electrode 28 with apertures 261, 262, 263 and apertures 261', 262', 263'.

It may also be possible to omit the electrode 28($G_{42}$) and to generate only a second quadrupole field by the electrode 27($G_{41}$) and 29($G_{43}$) which may cause some beam interception at the electrodes 27 ($G_{41}$) and 29($G_{43}$). Furthermore, in order to enhance the second quadrupole field it is possible to provide the apertures 271,272,273 and 277,278,279 in electrode 27 en 29 with raised, oppositely located edges.

Fig 3 shows a sectional view of a second example of an electron gun which is suitable for use in a cathode ray tube and display device according to the invention. The electron gun 6 comprises three cathodes 41,42,43. It further comprises a first common electrode 44 ($G_1$), a second common electrode 45 ($G_2$), a third common electrode 46 ($G_{31}$), a fourth common electrode 47 ($G_{32}$), a fifth common electrode 48 ($G_{33}$), a sixth common electrode 49 ($G_4$) and a seventh electrode 50($G_5$).Electrodes 48($G_{33}$), 49 ($G_{34}$) and 50($G_4$) form a distributed composed main lens field (DCFL) in spaces 51 and 52. The electrodes have connections for applying electric voltages. The display device comprises leads, not shown, for applying electric voltages which are generated in the means 15.

The electrodes 46($G_{31}$), 47 ($G_{44}$) and 48 ($G_{43}$) form an electron-optical element in the main lens portion of the electron gun for generating an auxiliary electric field, in this example, an astigmatic lens field, which is generated between the respective electrodes 46,47,48 ($G_{31}$,$G_{44}$,$G_{43}$)in space 53,54, at the anode side of the main lens whereby the intensity of the astigmatic lens field in the direction perpendicular to the in-line plane is stronger than the intensity of the astigmatic lens field in the in-line plane. The cathodes 41,42,43 and the electrodes 44 (G1) and 45 (G2) form the so-called triode portion of the electron gun. Electrodes 45 ($G_2$) provided with apertures 450,451,452 and 46 ($G_3$) form an electron-optical element in the prefocusing portion of the electron gun for generating a first prefocusing field approximately in space 55. Furthermore, electrodes 45 ($G_2$) and 46 ($G_{31}$) form an electron optical element in the prefocussing portion of the electron gun for generating an auxiliary electric field in space 55. In this example, a further astigmatic lens field. All electrodes have apertures for transmitting the electron beams. In this example, apertures 459, 460, 461 are rectangular as are apertures 462, 463, 464 and apertures 465, 466, 467. This is diagrammatically shown by means of rectangles beside the apertures. Apertures 453, 454 and 455, and apertures 456,457 and 458 are also rectangularly shaped as is diagrammatically shown beside said apertures.

In operation, a potential $V_{G2}$ is applied to electrode 45 ($G_2$), 47 ($G_{32}$). The intensity of the astigmatic field lens is adapted by the form of the apertures 459,460,461 and 462,463,464 and 465,466,467 in the electrodes 46($G_{31}$),47($G_{32}$),48($G_{33}$) in respective electrodes 46, 47 and 48. In order to provide a uniform spot size during deflection of the electron beam across the display screen, the potentials Vfoc and $VG_2$ provided to the respective electrodes 46,47,48 and the shapes of the apertures are chosen such that in the vertical direction the lens actions of the astigmatic lens field and the further astigmatic lens field intensify each other causing the electron beam to leave the main lens substantially parallel to the in-line plane whereby the diameter of the electron beam in the aperture of electrode 50 ($G_4$) of the main lens at the anode side is smaller than or equal to the diameter of the aperture 453,454,455 of the second electrode 45 $G_2$ throughout the deflecting of the electron beam across the display screen 10.

In this example it holds that

diameter of apertures in electrode 44 (G1): 0.575 (x) x 0.376(y)
diameter of apertures in electrode 45 (G2b): r=0.580
diameter of apertures in electrode 45 ($G_{2b}$): 0.520 (x) x 0.520 (y) mm
diameter of apertures in electrode 46 ($G_{3a}$): 0.500 (x) x 0.500 (y) mm
diameter of apertures in electrode 47 ($G_{3b}$): 4.750 (x) x 6.000 (y) mm
apertures 462, 463 and 464: 5.000(x) x 5.500 (y) mm
apertures 465, 466 and 467: 4.750 (x) x 6.000 (y)mm

The potential $V_{foc}$ provided to the electrodes 46 ($G_{31}$) an 48($G_{33}$) is 8000 V. The potential $V_{g2}$ is for example 800V. The potential $V_i$ provided to electrode 49 is 15 kV and the potential $V_{g4}$ provided to the electrode 50 is the anode potential being 30 kV. For this small diameter of the electron beam in the vertical direction, the electron beam will be in focus everywhere on the screen during deflection of the electron beam as well as in the center as in the corners of the screen.

Fig 4 shows a result of a simulation of the electron gun described with reference to Fig. 3.

The upper part of Fig.4 shows a cross-section of an electron beam in vertical direction in a electron gun according to the invention. The potentials on the respective electrodes $G_1$,$G_2$,$G_{31}$,$G_{32}$,$G_{33}$,$G_{34}$ and $G_4$ and the shape and dimensions of the apertures of the electrodes are such that causes the electron beam to leave the main lens substantially parallel to the in-line plane, the diameter D2 of the electron beam in a aperture of electrode 50(G4) of

the main lens at the anode side being smaller than or substantially equal to the diameter D1 of an aperture 453,454 and 454 of the second electrode 45 ($G_2$) throughout the deflecting of the electron beam across the display screen 3.

The lower part of Fig.4 shows the shape of the electron beam in a horizontal direction. Fig 4 shows the position of the respective electrodes $G_1$,$G_2$,$G_{31}$,$G_{32}$,$G_{33}$,$G_{34}$ and $G_4$ in the electron gun and that the diameter of the electron beam in the horizontal direction is much larger than the diameter of the electron beam in the vertical direction.

It will be clear that within the framework of the invention many variations are possible.

CLAIMS:

1. A display device comprising a cathode ray tube, a deflection unit and a display screen, the cathode ray tube including an in-line electron gun comprising

- a main lens section for generating a main lens field
- a pre-focus lens section comprising, seen in the direction of travel of the electron beams a first, a second and a third electrode for generating a pre-focussing lens field, wherein the electrodes are provided with apertures for transmitting the electron beam and
- the deflection unit being arranged for deflecting the electron beam across the display screen,

characterized in that the electron gun comprises means for generating an auxiliary lens field between the pre-focussing lens field and the main lens field, whereby, in operation, the intensity of the auxiliary lens field causes the electron beam to leave the main lens substantially parallel to the in-line plane, the diameter of the electron beam in a gap of main lens at the anode side being smaller than or substantially equal to the diameter of an aperture of the second electrode throughout the deflecting of the electron beam across the display screen.

2. A display device as claimed in Claim 1, characterized in that the means for generating an auxiliary lens field are adapted for generating a first quadrupole field in the main lens section and a second quadrupole field in the prefocus lens section.

3. A display device as claimed in Claim 1, characterized in that the means for generating the prefocussing field and the second quadrupole field are constructed so that, in operation, only one prefocussing lens and two quadrupole fields for building up the second quadrupole field, are generated in the prefocussing portion.

4. A display device as claimed in claim 3 characterized in that the in-line electron gun further comprises a fourth electrode, a fifth electrode, a sixth electrode, and a seventh electrode which electrodes have apertures for transmitting electron beams and in that the display device comprises means to apply the static voltage to the third, the fifth and the

seventh electrodes.

5. A display device as claimed in claim 1 characterized in that the means for generating an auxiliary lens field are adapted for generating an astigmatic lens field in the main lens section, whereby the intensity of the astigmatic lens field in the direction perpendicular to the inline plane is stronger than the intensity of the astigmatic lens field in the in-line plane.

6. A display device as claimed in claim 5 characterized in that the means for generating an auxiliary lens field are adapted for generating an astigmatic lens field in the pre focus lens section, whereby the intensity of the astigmatic lens field in the direction perpendicular to the inline plane is stronger than the intensity of the astigmatic lens field in the in-line plane.

7. A display device as claimed in claim 5 characterized in that the in–line electron gun viewed in the direction of travel of the electron beams, further comprises a fourth electrode, a fifth electrode, a sixth electrode, and a seventh electrode which electrodes have apertures for transmitting electron beams and in that the display device comprises means to apply a first static voltage to the second and fourth electrode, a second static voltage to the third and fifth electrodes and a third static voltage to the sixth electrode.

8. A cathode ray tube for use in a display device as claimed in one of the preceding claims.

ABSTRACT:

A display device comprising a deflection unit and a cathode ray tube having an in-line electron gun. The electron gun comprises a main lens portion having means to generate a main lens field and an auxiliary field. Furthermore, the electron gun comprises a prefocusing lens portion having a first, a second and a third electrodes for generating a prefocusing lens field. In operation the auxiliary field and the main lens causes, in a direction perpendicular to the in-line plane, the electron beam leaving the main lens substantially parallel to the in-line plane whereby the diameter of the electron beam at a gap of main lens at the anode side is smaller than or equal to the diameter of the aperture of the second electrode throughout the deflecting of the electron beam across the display screen. By virtue thereof, an improved picture reproduction can be obtained.

Fig. 3

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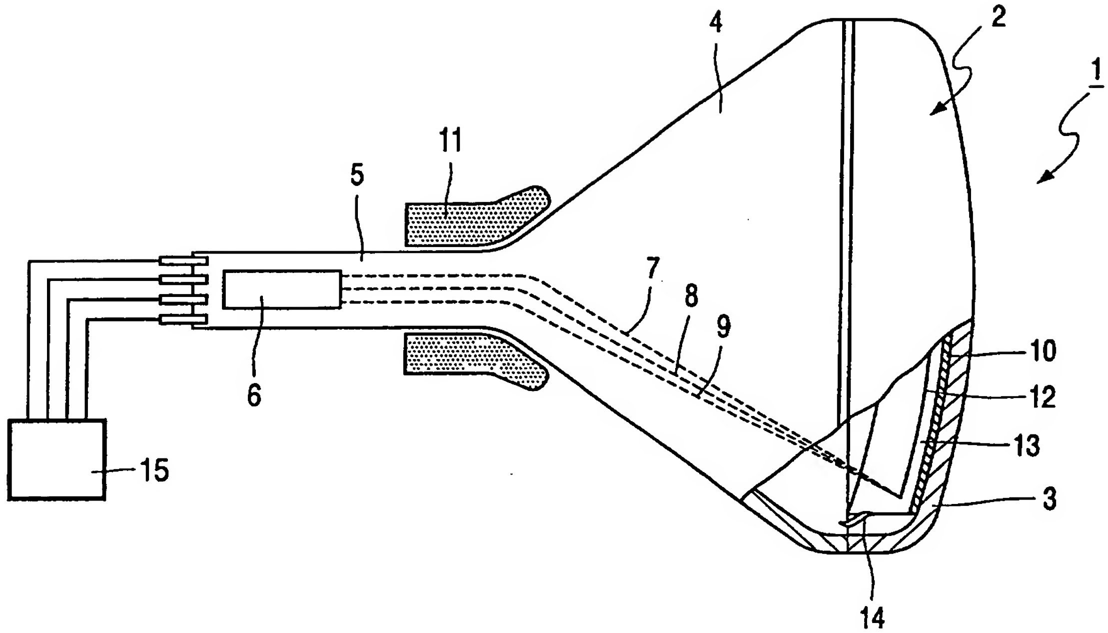
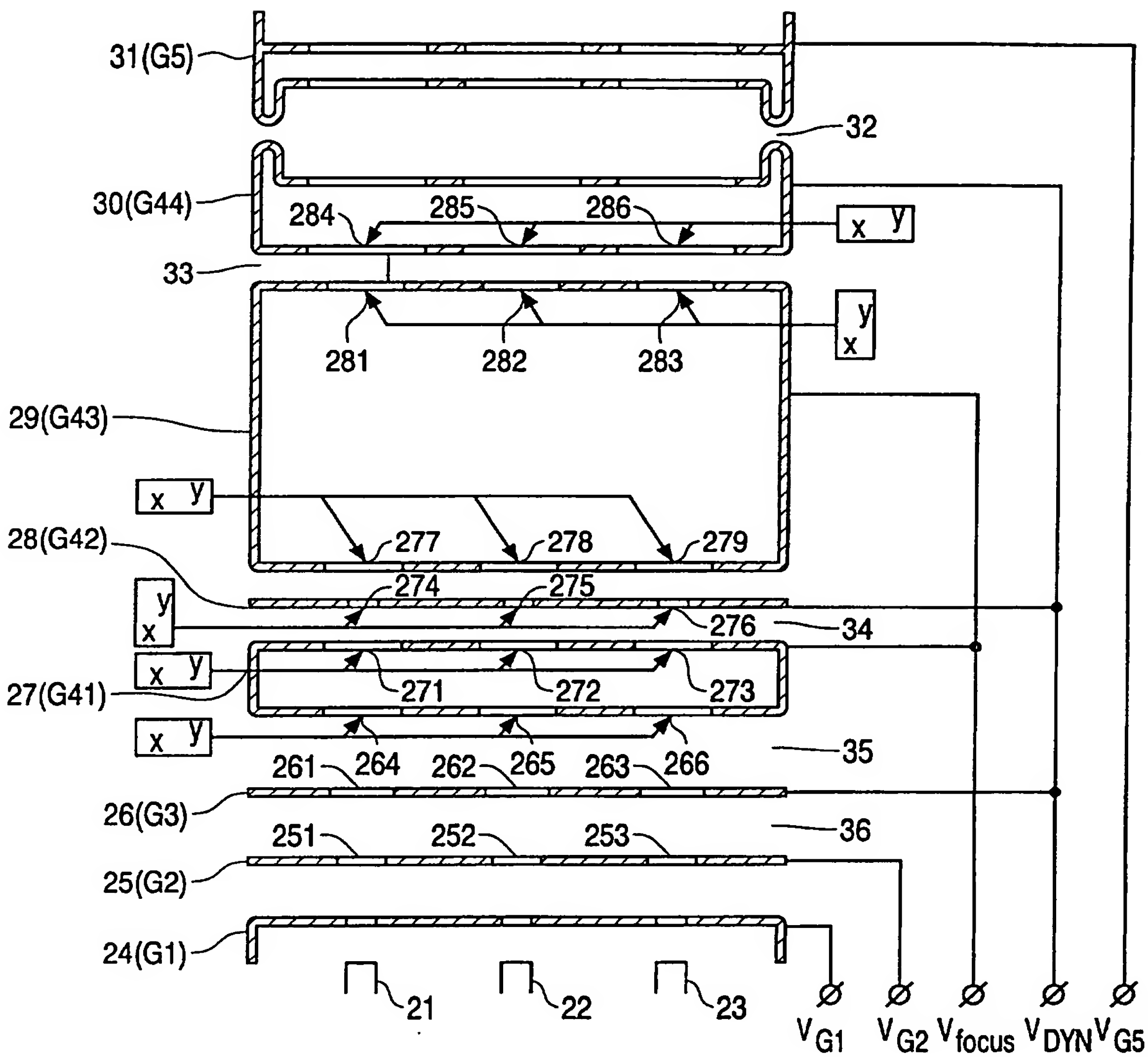



FIG. 1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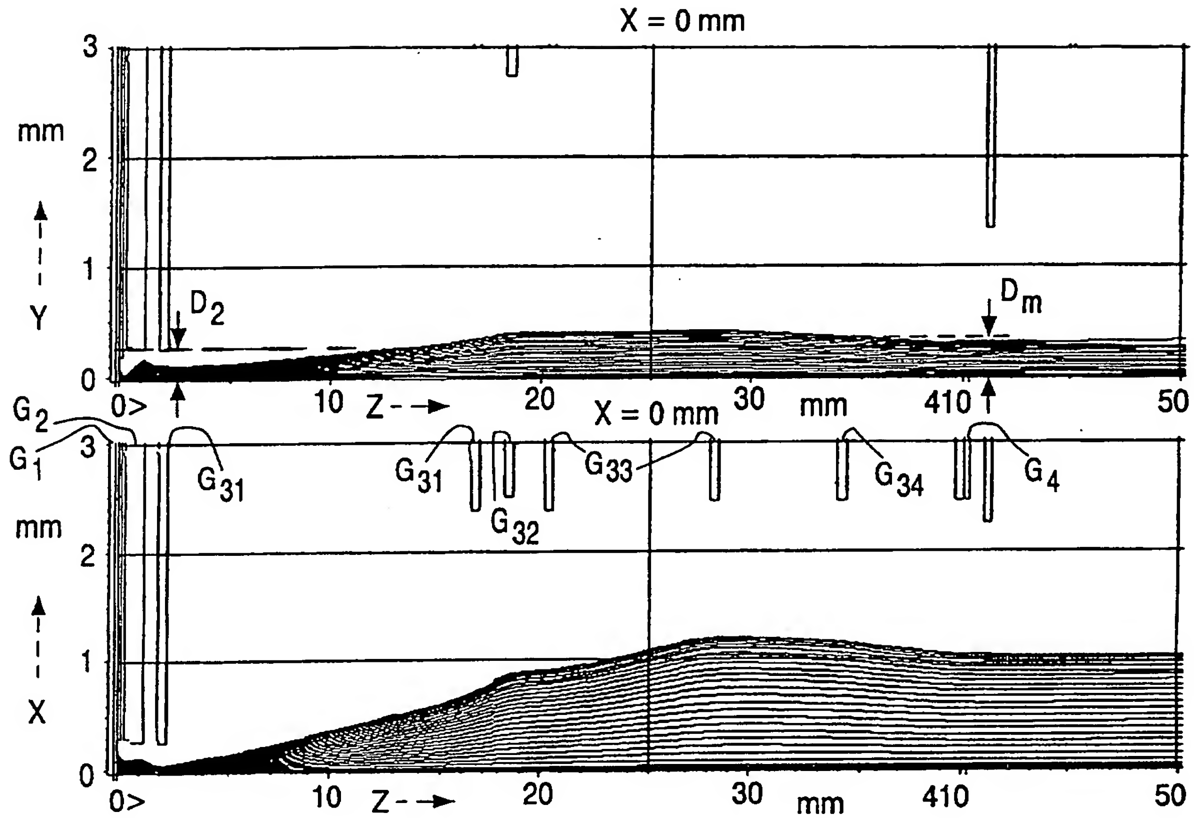
32
30(G44)
284
285
286
x y
33
281
282
283
y x
29(G43)
x y
277
278
279
28(G42)
274
275
276
34
y x
x y
27(G41)
271
272
273
x y
35
261
264
262
265
263
266
26(G3)
251
252
253
36
25(G2)
24(G1)
21
22
23
$V_{G1}$
$V_{G2}$
$V_{focus}$
$V_{DYN}$
$V_{G5}$

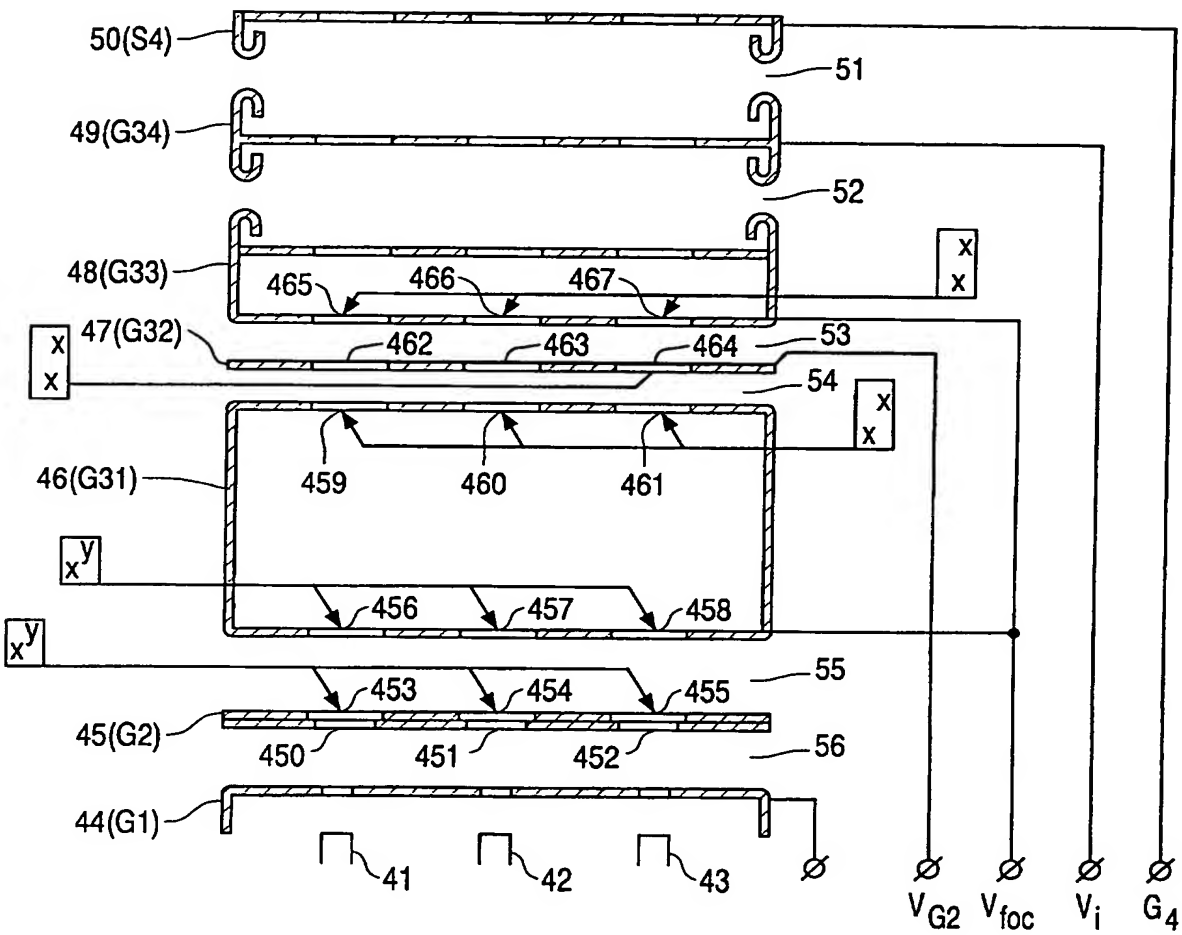
FIG. 2



X = 0 mm
mm
Y
D2
Dm
0>
10
Z
20
30
mm
410
50
X = 0 mm
G2
G1
G31
G31
G32
G33
G34
G4
mm
X
0>
10
Z
20
30
mm
410
50


FIG. 4

3/4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455
55
45(G2)
450
451
452
56
44(G1)
41
42
43
$V_{G2}$
$V_{foc}$
$V_i$
$G_4$

FIG. 3